

ACTION ITEMS

LCD III POWER-UP PROBLEM

I. PROBLEM:

THE SUBROUTINE STACK IS CLEARED ON POWER-UP. SINCE WE TURN OFF BETWEEN EACH KEY PUSH IT IS POSSIBLE TO HAVE SOMETHING STILL IN THE STACK. THIS OCCURS ON FIELD INSTRUCTIONS.

POSSIBLE SOLUTIONS:

	IMPACT
1. MODIFY TP0485 TO NOT CLEAR SUBROUTINE STACK.	2 WEEKS MIN.
2. MODIFY ALGO TO AVOID PROBLEM.	1 WEEK
3. DON'T TURN OFF ON FIELD INSTRUCTIONS.	1 DAY/POWER?

ACTION: PCC DECISION ON WHICH SOLUTION SHOULD BE IMPLEMENTED.

II. PROBLEM:

SEVERAL PEOPLE HAVE COMMENTED THAT OUR BUZZER SOUNDS "SILLY" OR "UNPROFESSIONAL" AND THE SOUND LEVEL IS VERY LOW COMPARED TO SIMULATION IN PCC LAB.

ACTION: PCC DECISIONS ON ACCEPTABILITY OF LOUDNESS AND "QUALITY" OF SOUND.

ACH

039/639

06/06/80

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 10/24/1980

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

THE DECISION WAS MADE TO ELIMINATE THE NOTATION OF SIN 2 (SIN SQUARED) ON 10/20/80. THIS HAS BEEN COMPLETED AND SOLVES THE ROM PROBLEM ON THE ARITHMETIC CHIP. FIXES FOR KNOWN BUGS HAVE ALL BEEN IDENTIFIED EXCEPT FOR THE ONES WHICH WE CONSIDER ACCEPTABLE. ALEX IS SCHEDULED TO START 10/27/80 AND WILL TAKE 2 WEEKS. OPD IS SCHEDULED FOR 11/7/80. THERE IS A POSSIBLE RISK IN THE OPD DATE DUE TO THE HARDWARE USED FOR CHECKING OUT THE CASSETTE OPS WHICH SEEMS TO BE SOMEWHAT UNRELIABLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4210	4219
KEYBOARD/ARITHMETIC	4160	4219
SYSTEM CROM	14980	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
139	134	127

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER  
 EXT: 2371  
 PROGRAM: TI-88

WEEK ENDING 10/31/1980

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

ALEX WAS DELAYED UNTIL NEXT WEEK. A NEW VERSION OF LOW BATTERY TEST WAS DEFINED AND IMPLEMENTED AND A POSSIBLE LOCKUP CONDITION IN THE PERIPHERAL I/O CODE WAS CORRECTED. LINDA IS IN HOUSTON TO HELP DEBUG A NEW PASS OF TPO475 PARTS. ALEX IS SCHEDULED TO START 10/31/80 AND WILL TAKE 2 WEEKS. GPD IS SCHEDULED FOR 11/14/80. THE GREATEST PROBLEM FOR TI-88 SOFTWARE COMPLETION IS AVAILABILITY OF SIMULATOR TIME. SIMULATORS WILL BE SCHEDULED FROM 6:00 AM UNTIL MIDNIGHT, BUT THIS WILL STILL LIMIT THE TIME AVAILABLE FOR THESE ACTIVITIES:

1. ALEX AND ALGORITHM CORRECTIONS
2. CROM LIBRARY DEVELOPMENT
3. CASSETTE INTERFACE DEVELOPMENT
4. PRINTER DEVELOPMENT
5. PCC EVALUATION
6. USER MANUAL WRITERS

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4210	4219
KEYBOARD/ARITHMETIC	4165	4219
SYSTEM CROM	14990	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
142	136	127

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 11/21/1980

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

THE SYSTEM CROM GPD WAS SHIPPED ON 11/17/80 AND BOTH 485 GPD'S WERE SHIPPED 11/18/80 AS SCHEDULED. ALL IDENTIFIED BUGS WERE FIXED FOR THIS RELEASE. A WORKING CD2901 BAR WAS FOUND THAT COMMUNICATED WITH THE SIMULATOR (CD2902). NO NEW CHIP PROBLEMS WERE DETECTED. ALEX PERTAINING TO THE PRINTER, CASSETTE, COMMUNICATION BETWEEN TIB8'S, AND THE MEMORY FUNCTIONS IS STILL GOING ON.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4212	4219
KEYBOARD/ARITHMETIC	4180	4219
SYSTEM CROM	14999	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
156	156	156

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: TOM KOSLOSKI  
EXTENTION: 3498  
PROGRAM(S): CA-800

WEEK ENDING 12/12/1980  
ON SCHEDULE? NO

WEEK'S ACCOMPLISHMENTS:

THE LOW BATTERY INDICATOR (LBI) CONNECTION OF THE X1123  
POWER SUPPLY CHIP HAS BEEN TRANSFERED FROM /KON TO K1,  
TO SIMPLIFY TESTING.

IMPLEMENTING ERROR DETECTION AND CORRECTION ROUTINES.  
DATA IS RECORDED TWICE WITH A CHECK SUM FOR EACH  
DATA BLOCK.

NEW CA-800 BOARD WORKES A LOT BETTER WITH SHIELDED CABLE.

NEXT WEEK'S PLANS:

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 12/12/1980

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

ALEX PERTAINING TO THE CASSETTE, COMMUNICATION BETWEEN TIB8'S, AND THE MEMORY FUNCTIONS IS STILL GOING ON. SEVERAL NEW BUGS WERE FOUND AND FIXED. TRACE WAS CHANGED SO THAT FUNCTIONS NOT RELATED TO EOS NEVER STAY IN THE DISPLAY LONGER THAN THE TIME IT TAKES TO EXECUTE THE FUNCTION AS REQUESTED BY THE PUBLICATIONS GROUP. ERROR DETECTION WENT FROM 3.2 TO 2.4 SECONDS BY REWRITING THE CROM CODE INVOLVED. BASED ON THE POSSIBILITY OF SMART RAMS BEING IMPLEMENTED, FIXES FOR EQN MODE, THE OFF KEY, AND SPEED UPS IN THE MICROCODE FOR ERRORS WERE DETERMINED.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4217	4219
KEYBOARD/ARITHMETIC	4187	4219
SYSTEM CROM	14980	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
163	160	159

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 01/09/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

REVISED THE ORDER OF EXECUTION FOR ROUTINES ON THE ARITHMETIC CHIP AND REWROTE THE KEYBOARD SCAN AND TIME UPDATE ROUTINES IN ORDER TO REDUCE THE AMOUNT OF TIME THE MEMORY CONTROLLER HAS TO WAIT FOR A RESPONSE DURING H/W FUNCTIONS OR USER PROGRAM EXECUTION. THIS PRODUCED A SPEEDUP OF ABOUT 35 PERCENT FOR ALL OF THESE OPERATIONS.

CONTINUED PACKING THE MEMORY CONTROLLER CHIP IN ORDER TO IMPROVE THE OPERATION OF SOME FEATURES OR FURTHER IMPROVE THE SPEED OF SOME FUNCTIONS.

NEED PCC DIRECTION ON WHICH FEATURES TO CHANGE AND WHICH SPEED IMPROVEMENTS ARE MOST DESIRABLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4234	4219
KEYBOARD/ARITHMETIC	4199	4219
SYSTEM CROM	14950	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
167	163	162

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 01/16/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

ADDED SEVERAL MORE CHANGES TO IMPROVE FEATURES AND EXECUTION SPEED. CHANGED DFN RCL A TO DFN A. THIS CHANGES THE WAY OPS ARE DEFINED TO INV OP INSTEAD OF 2ND DFN OP WHICH IS FEWER KEY STROKES FOR EACH OPERATION. SPEEDED UP ERRORS AND FURTHER SPEEDED UP USER PROGRAMS BY ABOUT 10 PERCENT.

CONTINUED PACKING THE MEMORY CONTROLLER CHIP IN ORDER TO IMPROVE THE OPERATION OF SOME FEATURES OR FURTHER IMPROVE THE SPEED OF SOME FUNCTIONS.

NEED PCC DIRECTION ON WHICH FEATURES TO CHANGE AND WHICH SPEED IMPROVEMENTS ARE MOST DESIRABLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4202	4219
KEYBOARD/ARITHMETIC	4210	4219
SYSTEM CROM	14975	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
171	166	162

PROBLEMS ENCOUNTERED AND/OR COMMENTS:



PERSONAL PROGRESS REPORT -- WEEKLY

NAME: TOM KOSLOSKI  
EXTENTION: 3498  
PROGRAM(S): CA-800

WEEK ENDING 01/24/1981  
ON SCHEDULE? NO

WEEK'S ACCOMPLISHMENTS:

INCORPERATED HAND SHAKING BETWEEN TI-88 AND CA-800 FOR WRITE ID# AND FIND ID#. SOME SPEED PROBLEMS ENCOUNTERED.

TESTING PROTOTYPE 455 BARS ON WAFER WITH STEVE EASLEY. MOST CHIPS HAVE VERY FAST MOS CLOCKS. THE INSTRUCTION TIMES HAVE BEEN BETWEEN 8 TO 11.7 MICRO. SEC.

THE WORKING CHIPS RESPOND TO THE COMMANDS SENT THEM, BY TURNING ON THE MOTOR CONTROL, TRANSMITTING DATA TO CASSETTE PLAYER, TURNING OFF MOTOR CONTROL, TURN ON MOTOR FOR READ FROM CASSETTE. DATA FREQ. IS FAST. ABOVE 4KHZ FOR THE 3KHZ SIGNAL. WHEN STEVE EASLEY SLOWED DOWN THE MOS CLOCK THE CHIP STARTED TO READ SOME DATA FROM CASSETTE. STILL TESTING.

NEXT WEEK'S PLANS:

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: SUSAN BAILEY  
EXTENTION: 2413  
PROGRAM(S): MBAII

WEEK ENDING 01/24/1981  
ON SCHEDULE? YES

WEEK'S ACCOMPLISHMENTS:

FINISHED KEYING IN THE IRR AND NPV CALCULATIONS AND  
IRR SEEMS TO WORK.

STARTED WORKING ON THE NEC CALCULATIONS

PC800:

WE DECIDED THAT THE PC800 MOTOR CAN NOT  
HANDLE EXTRA LONG PULSES. THEREFORE  
I MADE EXTENSIVE ALGORITHM CHANGES WHICH  
APPEAR TO HAVE FIXED THE MOTOR ADVANCE  
PROBLEM AS WELL AS INCREASED THE PRINT SPEED.  
THERE HAVE BEEN SOME DESIGN CHANGES  
WHICH WILL REQUIRE MORE ALGORITHM CHANGES  
IN BOTH THE 1300, AND THE 1000 CHIP.

NEXT WEEK'S PLANS:

MBA-II:

FINISH THE NEC KEY.

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ALICE MYERS  
EXT: 3496  
PROGRAM: TI-82

WEEK ENDING 01/23/1981

WEEK'S ACCOMPLISHMENTS:

I AM CURRENTLY INCORPORATING CHANGES IN THE 485'S  
AND THE 532 WHICH ARE BEING MADE IN THE TI-88.  
I AM MAKING SPEED IMPROVEMENTS ON DOWNLOAD  
ON THE TI-88 AND THE TI-82.  
I AM HELPING TO DEBUG THE CASSETTE INTERFACE.  
I RETIMED THE CROM FUNCTIONS FOR THE TI-88. THE SPEEDS  
ARE ALSO VALID ON THE TI-82.

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 01/23/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

CONTINUED EVALUATING AND IMPLEMENTING CHANGES TO REDUCE COMPLEXITY AND IMPROVE USABILITY. REMOVED TIME FROM THE ON KEY AND CHANGED IT TO ON/OFF ONE DIRECTION AND PROMPT THE OTHER. REMOVED UNARY MINUS AND MOVED READ TO THE OP CODES.

CONTINUED PACKING THE MEMORY CONTROLLER CHIP IN ORDER TO IMPROVE THE OPERATION OF SOME FEATURES OR FURTHER IMPROVE THE SPEED OF SOME FUNCTIONS. NEED PCC DIRECTION ON WHICH FEATURES TO CHANGE AND WHICH SPEED IMPROVEMENTS ARE MOST DESIRABLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4198	4219
KEYBOARD/ARITHMETIC	4207	4219
SYSTEM CROM	14960	15000

# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
172	168	167

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ALICE MYERS  
EXT: 3496  
PROGRAM: TI-82

WEEK ENDING 01/30/1981

WEEK'S ACCOMPLISHMENTS:

I AM CURRENTLY INCORPORATING CHANGES IN THE 485'S  
AND THE 532 WHICH ARE BEING MADE IN THE TI-88.  
I ALTERED MY CASSETTE OP CODES TO HELP CHECK OUT  
455 CHIPS FOR THE CA800.  
I AM RENUMBERING THE OP CODES AND REWRITING THE CASSETTE  
OPS FOR BOTH THE 86 AND THE 88.

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: SUSAN BAILEY  
EXTENTION: 2413  
PROGRAM(S): MBAII

WEEK ENDING 01/31/1981  
ON SCHEDULE? YES

WEEK'S ACCOMPLISHMENTS:

STARTED DOING CLEAN UP WORK ON THE ANNUITIES, SO THAT  
THE ALGORITHM CAN BE CHECKED OUT EARLY.

STILL WORKING ON THE NEC CALCULATIONS

PC800:

MADE THE REQUESTED ALGOORITHM CHANGES  
1. CHANGED THE MESSAGES WHICH ARE SENT TO THE TI-88  
2. CHANGED THE CHARACTER SET, "-" AND "+".  
THE CHANGES WORK BUT THE COMMUNICATIONS NEED  
TO BE CHECKED OUT AT ALL FREQUENCIES, BEFORE  
RESHIPPING.

NEXT WEEK'S PLANS:

MBA-II:

FINISH THE NEC KEY, AND CLEAN UP FOR ANNUITIES.

PC800:

RESHIP GPD AFTER ALEX.

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: TOM KOSLOSKI  
EXTENTION: 3498  
PROGRAM(S): CA-800

WEEK ENDING 01/30/1981  
ON SCHEDULE? NO

WEEK'S ACCOMPLISHMENTS:

CHANGED CA-800 ERROR PROCEDURES.

IF AN ERROR HAS OCCURED, CA-800 WILL FILL THAT REGISTER WITH F'S AND SEND IT TO THE TI-88 AS DATA. AT THE END OF THE TRANSMISSION AN ERROR INDICATOR WILL BE SENT BACK WITH THE END OF DATA CODE.

THE FREQUENCY SENT TO THE CASSETTE PLAYER IS BEING LOWERED FROM 3KHZ TO 2.4KHZ AND 1KHZ TO 0.8KHZ TO SEE IF THE DATA RECOGNITION IMPROVES AT SLOW CHIP SPEEDS.

NEXT WEEK'S PLANS:

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 01/30/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

CONTINUED EVALUATING AND IMPLEMENTING CHANGES  
TO REDUCE COMPLEXITY AND IMPROVE USABILITY.  
REMOVED SPECIAL ALPHA CHARACTERS FROM OVERLAY  
AND REDEFINED HOW THEY ARE ENTERED. MOVED SEVERAL  
KEYS TO IMPROVE USABILITY.

CONTINUED PACKING THE MEMORY CONTROLLER CHIP  
IN ORDER TO IMPROVE THE OPERATION OF SOME  
FEATURES OR FURTHER IMPROVE THE SPEED OF  
SOME FUNCTIONS.  
NEED PCC DIRECTION ON WHICH FEATURES TO CHANGE  
AND WHICH SPEED IMPROVEMENTS ARE MOST DESIRABLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4202	4219
KEYBOARD/ARITHMETIC	4183	4219
SYSTEM CROM	14960	15000

# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
173	171	167

PROBLEMS ENCOUNTERED AND/OR COMMENTS:



PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 02/13/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)  
 CONTINUED EVALUATING AND IMPLEMENTING CHANGES  
 TO REDUCE COMPLEXITY AND IMPROVE USABILITY.  
 COMPLETED THE REVISION TO ALLOW CHANGE SIGN (+/-)  
 TO BE ENTERED BEFORE OR AFTER THE OPERAND. BEGAN  
 CHANGING QUE OR R/S MODE TO ELIMINATE ACCIDENTALLY  
 TRAPPING AN UNFAMILIAR USER.

BEGAN TESTING THE CASSETTE INTERFACE FOR  
 GPD RELEASE WITH THESE NEW FEATURES:

1. LOWERED THE FREQUENCIES ON THE TAPE FOR  
 BETTER STABILITY WITH CASSETTE SPEED  
 VARIATION.
2. CHANGED THE PROCEDURE WHEN AN ERROR IS  
 DETECTED TO ALLOW THE USER TO RECALL  
 AS MUCH DATA AS POSSIBLE.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4187	4219
KEYBOARD/ARITHMETIC	4204	4219
SYSTEM CROM	14895	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
173	172	167

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 02/20/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

CONTINUED EVALUATING AND IMPLEMENTING CHANGES TO REDUCE COMPLEXITY AND IMPROVE USABILITY. COMPLETED CHANGE IN EQN MODE SO THAT THE END OF THE EQUATION IS SHOWN WHEN GOING BACK INTO EQN INSTEAD OF THE BEGINNING. COMPLETED CHANGES TO QUE OR R/S MODE TO AUTOMATICALLY CANCEL INSTEAD OF SHOWING AN ERROR CONDITION.

SHIPPED OPD FOR CA-800 CASSETTE INTERFACE.

WILL BEGIN ALEX TESTING AS SOON AS OP CODE ORDER IS DETERMINED AND IMPLEMENTED.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4199	4219
KEYBOARD/ARITHMETIC	4211	4219
SYSTEM CROM	14995	15000

# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
173	172	171

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ALICE MYERS

WEEK ENDING 03/13/1981

EXT: 3496

PROGRAM: TI-86, TI-88

WEEK'S ACCOMPLISHMENTS:

CODED CHANGES IN MOTOR CONTROL AND ALPHA MESSAGES  
IN CASSETTE OPS, NOW IMPLEMENTING CHANGE  
IN CASSETTE OPS TO CHANGE DISPLAY WHILE READING IN DATA.

FIXING BUGS AS THEY ARE FOUND.

CODING CHANGE IN PROGRAM WHICH SETS THE CHIP SELECT.

CHANGING PROMPTING SEQUENCE TO PUT 0 IN SWAP REGISTER AND  
IN DISPLAY BEFORE ASKING ANY QUESTION.

CURRENTLY ATTEMPTING TO SQUISH 30-40 STEPS OF CODE IN ORDER  
TO FIT IN THE CHANGES BEING MADE.

ALSO READING THE MANUAL TO CHECK IT FOR INACCURACIES AND  
STYLE PROBLEMS.

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 04/09/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

CONTINUED ALEX TESTING. BEGAN CHANGES TO ALLOW PROTECTED CRAMS. PCC DECIDED TO REMOVE MEMORY EXPANSION CAPABILITY IN ORDER TO ADD CRAM PROTECTION CAPABILITY. THESE CHANGES WILL TAKE ABOUT TWO WEEKS WITH ABOUT TWO WEEKS OF ADDITIONAL ALEX NECESSARY AFTERWARDS. GPD COULD BE RELEASED AROUND MAY 6, 1981.

ALEX FOUND 6 BUGS THIS WEEK.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4216	4219
KEYBOARD/ARITHMETIC	4203	4219
SYSTEM CROM	14988	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
71	67	44

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 04/16/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

ALICE AND LINDA COMPLETED THE DELETION OF MEMORY EXPANSION CAPABILITY IN ORDER TO ADD CROM PROTECTION CAPABILITY. THE CALCULATOR WILL HAVE PROTECTED CRAMS WITH OR WITHOUT ENCODING. A NEW OP CODE WILL SET A PROTECTION BIT, AND A SPECIAL SSS LIBRARY MAY BE USED FOR FURTHER PROTECTION BY ENCODING THE DATA. ALGO CROM IS OVER THE ROM LIMIT. WORKED WITH THE LOGIC ANALYZER TO DETERMINE THE ROM PROBLEM ON THE PROTOTYPE SYSTEMS. IT WAS DETERMINED THAT SOME OF THE TPO532'S WILL NOT WORK UNLESS THE LOW SPEED CLOCK IS HELD HIGH IN THE CALCULATOR IDLE STATE. GAYER WILL START PROBING SLICES TO DETERMINE WHAT CAUSES THIS PROBLEM.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4181	4219
KEYBOARD/ARITHMETIC	4203	4219
SYSTEM CROM	15120	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
74	68	45

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

PERSONAL PROGRESS REPORT -- WEEKLY

NAME: ART HUNTER

WEEK ENDING 04/30/1981

EXT: 2371

PROGRAM: TI-88

ART, LINDA, ALICE, ELAINE

WEEK'S ACCOMPLISHMENTS:

\* TI 88 - (ART 2371, LINDA 2368, ALICE 3496, ELAINE 3301)

ALICE AND LINDA CONTINUED CODING AND TESTING THE CHANGES WHICH HAVE BEEN MADE FOR CROM PROTECTION CAPABILITY. THE CALCULATOR WILL HAVE PROTECTED CRAMS WITH OR WITHOUT ENCODING. A NEW OP CODE WILL SET A PROTECTION BIT, AND A SPECIAL SSS LIBRARY MAY BE USED FOR FURTHER PROTECTION BY ENCODING THE DATA. ALGO CROM IS NOW WITHIN THE LIMIT FOR ROM WORDS. OP CODE ORDER WAS SLIGHTLY REVISED TO ADD THE PROTECT OP CODE AND TO ELIMINATE THE OP CODES THAT REMOVED AND REPLACED THE LEARN PROGRAM COUNTER. ALEX WILL RESUME ON 05/04/81 WITH A GOAL OF SHIPPING GPDS ON 05/15/81. MORE ALEX WILL BE NEEDED AFTER THIS RELEASE TO INSURE A LOW PROBABILITY OF ERRORS IN FINAL PRODUCT.

ROM WORDS USAGE	# WORDS USED	TOTAL AVAILABLE
MEMORY CONTROLLER	4180	4219
KEYBOARD/ARITHMETIC	4210	4219
SYSTEM CROM	14960	15000
# OF ERRORS FOUND	# CORRECTED	# CONFIRMED
76	71	45

PROBLEMS ENCOUNTERED AND/OR COMMENTS:

TO: JERRY BROWN  
DON O'GRADY  
DAVE THOMAS  
IVAN ZOTTICH

JOHN DALE  
JOHN SEDMAK  
DARRELL WHITTEN

CC: JOHNNY BARRETT  
DAN ENZONE

PETE BONFIELD

FROM: ART HUNTER

SUBJECT: TI-88 FEATURE CHANGES

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\* R E V I S E D \*  
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AFTER REVIEWING THE COMMENTS OF PEOPLE USING THE TI-88 SIMULATOR, WE HAVE MADE A NUMBER OF FEATURE CHANGES TO IMPROVE THE USABILITY OF THE PRODUCT. THIS IS A LIST OF ITEMS WHICH HAVE BEEN CHANGED AND THOSE UNDER CONSIDERATION. PLEASE INFORM THE PEOPLE IN YOUR ORGANIZATIONS WHO WILL BE AFFECTED BY THESE CHANGES.

FEATURE	SCHEDULE
1. REMOVE TIME AND PROMPT FROM ON KEY TOGGLE ON/OFF TO THE RIGHT TOGGLE PROMPT ON AND OFF TO THE LEFT	COMPLETE
2. MOVE READ TO OP CODES AND REPLACE WITH TIME ON THE OVERLAY	COMPLETE
3. REMOVE UNARY MINUS AND ADD TRACE TO OVERLAY (INV TRACE TO TURN OFF)	COMPLETE
4. MOVE DMS TO OP CODES AND ADD FF TO OVERLAY (WAS INV RST)	COMPLETE
5. CHANGE DFN RCL A SEQUENCE TO DFN A AND DFN OP CODES TO INV OP CODES	COMPLETE
6. REMOVE SPECIAL ALPHA CHARACTERS FROM OVERLAY AND REDEFINE A SIMPLER ENTRY METHOD - BLOCK FUNCTION MOVED FROM = TO R/S	COMPLETE
7. REORGANIZED OP CODE ORDER FOR BETTER CONSISTANCY BY TYPES AND GROUPING OF TI-86 OP CODES	ON GOING/AWAITING PCC APPROVAL
8. REDEFINE EQN AS A KEYBOARD MODE	UNDER CONSIDERATION
9. REDEFINE QUE OR R/S MODE ERROR	EVALUATING POSSIBLE CHANGES
10. SWAP THE POSITIONS OF THE ENT AND CONT KEYS	***** * MOVED BACK TO ORIGINAL * * POSITIONS 2/12/81 * *****

SWAPPING THESE KEYS CAUSED INCONSISTANCIES IN THE DEFINITION OF THE QUE FUNCTIONS WHEN THEY ARE PROGRAMMED BY THE USER. MANY PEOPLE COMPLAINED, AND WE MOVED ENT AND CONT BACK TO THEIR ORIGINAL POSITIONS ON 2/12/81.

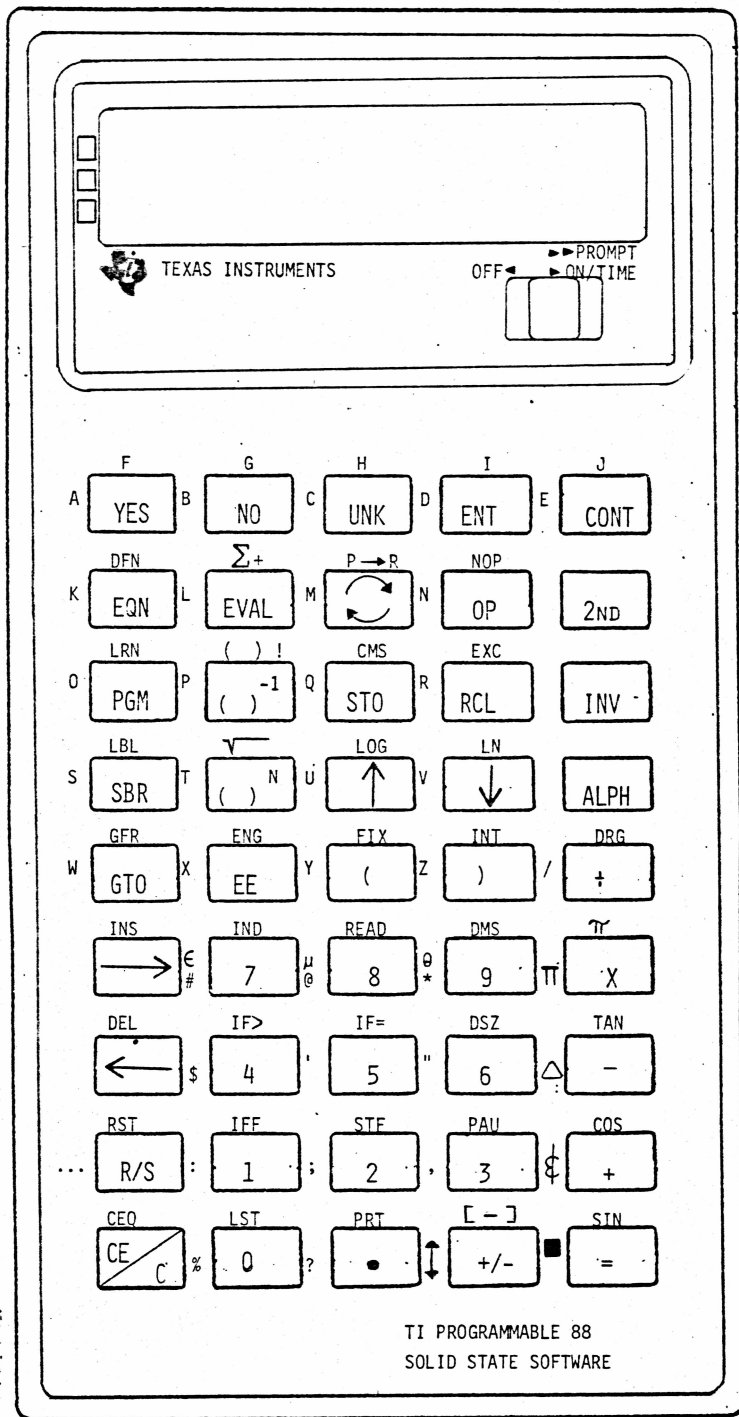




TI-88 CHANGES : 1981

1. REVISED EXECUTION ORDER TO SPEED UP RUN MODE 40 PER CENT 1/09/81
2. DFN RCL A WAS CHANGED TO DFN A 1/16/81  
DFN OP'S WERE CHANGED TO INV OP'S  
ERROR DETECTION SPEED WAS IMPROVED
3. MOVED KEYS AROUND ON KEYBOARD TO AVOID PROBLEMS WITH ON KEY 1/23/81  
UNARY MINUS WAS REPLACED WITH THE TRACE KEY
4. REDEFINED ALPHA MODE 1/30/81  
ADDED AN OP CODE FOR A LIST OF ALPHA CHARACTERS  
ADDED AN OP CODE TO SHOW FLAG DEFINITIONS
5. CHANGE SIGN WAS REDEFINED TO INCLUDE UNARY MINUS FEATURES 2/06/81
6. THE INV INDICATOR WAS REPLACED BY THE EQN INDICATOR 2/16/81  
CHANGED SCIENTIFIC NOTATION TO DISPLAY SUPERSCRIPIT NUMBERS  
CASSETTE OPS WERE CHANGED SO THE USER NO LONGER SPECIFIES  
THE AMOUNT TO BE READ AND THE ENTIRE AMOUNT IS READ  
WHEN AN ERROR IS DETECTED
7. CUE OR R/S MODE NO LONGER GENERATES AN ERROR 2/20/81  
EQN DISPLAY SHOWS END OF EQUATION
8. OP CODES WERE REARRANGED 2/27/81
9. CASSETTE OPS WERE CHANGED TO ALLOW THE USER TO MOVE THE 3/13/81  
TAPE WHILE CONNECTED TO THE CA-800
10. REMOVE EXPANSION MEMORY TO MAKE ROOM FOR PROTECTED CRAMS 4/10/81
11. REMOVE THE 2 OP CODES TO SHOW AND ELIMINATE LRN PC 4/27/81  
TO MAKE ROOM FOR 1 OP CODE TO PROTECT CRAMS

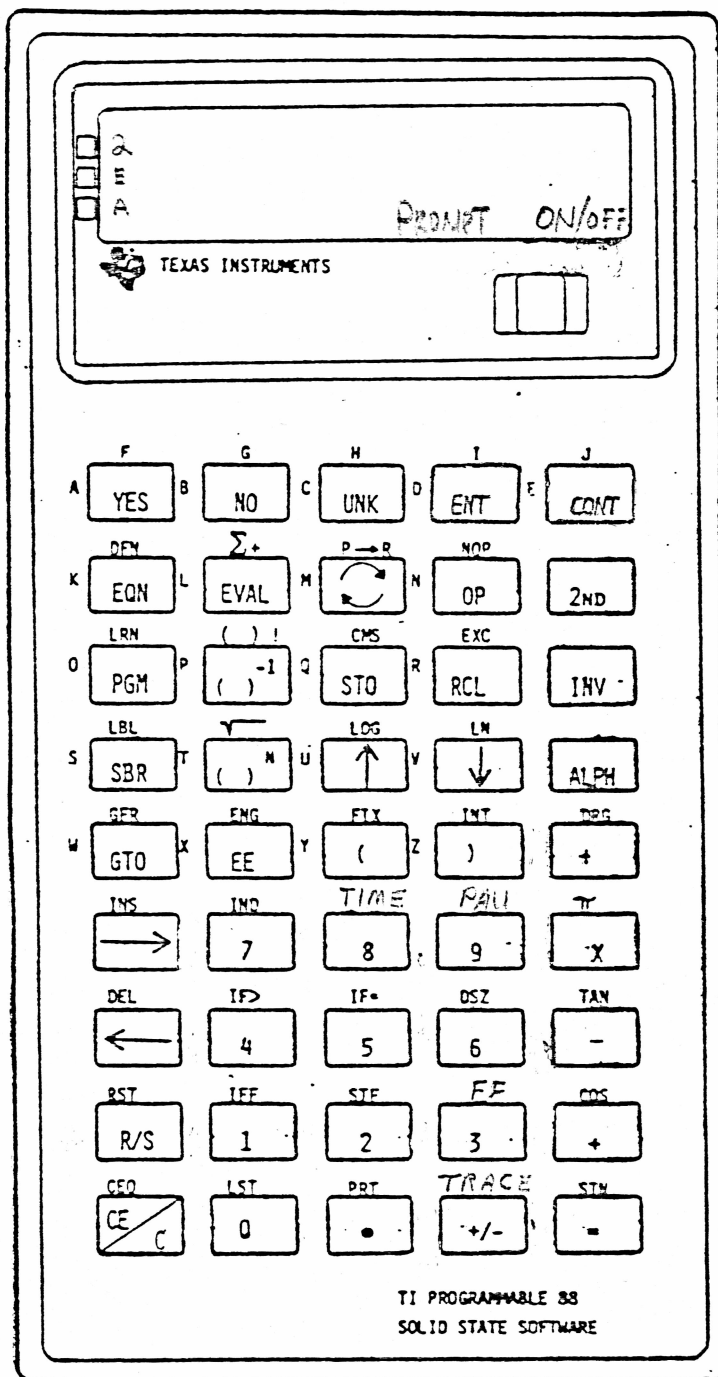
ACH 39/639 4/27/81



TI STRICTLY PRIVATE

5/19/80

OK July 1980



TI STRICTLY PRIVATE

2/09/81  
5/29/88

OK March 1981

Early July 1980

Prod X A1

OP CODE LIST

<u>OP#</u>	<u>FUNCTION</u>	<u>INV FUNCTION</u>
0	List Op Code Definitions	
1	Set Default States	
2	Recall error code	
3	Set Partition	Set Default Partition (26 Regs.)
4	All Response Que	
5	Yes/No Que	
6	Ent/Cont Que	
7	Cont Que	
8	Octal Conversion	
9	Recall Alpha	
10	Decimal Conversion	
11	Module # in Master Slot	
12	Angular mode	
13	Round display	
14	Save Status & User Flags	Exchange Status & User Flags
15	A/N Right Circular Shift	A/N Left Circular Shift
16	Hex Conversion	
17	Set Implied Multiply	Reset Implied Multiply
18	Degrees -> Radians	Radians -> Degrees
19	Radians -> Grads	Grads -> Radians
20	Grads -> Degrees	Degrees -> Grads
21	Self Test #1	Self Test #2
22	Clear Statistics	
23	Intercept $\approx$ Slope	
24	Correlation Coefficient	
25	Y Prediction	X Prediction
26	Means	Standard Error of Means
27	Standard Deviation (N-1)	Standard Deviation (N)
28	Absolute Value	Signum Function

Early July 1980

OP CODE LIST

(continued)

<u>OP#</u>	<u>FUNCTION</u>	<u>INV FUNCTION</u>
29	Show Which Flags Are Set	
30	24 Hour Mode	12 Hour Mode
31	Set Pause Timing	Default Pause Timing (1.5 sec)
32	List Program Labels	
33	Read Cassette into Main Memory	Write Main Memory to Cassette
34	Read Cassette into Numbered Module	Write Numbered Module to Cassette
35	Read Cassette into Program Memory	Write Program Memory to Cassette
36	Read Cassette into Data Memory	Write Data Memory to Cassette
37	Display -> PGM Counter	PGM Counter -> Display
38	Display -> PGM Step	PGM Step -> Display
39	Exchange Display with PGM Step & Increment PC	Exchange Display with PGM Step & Decrement PC
40	Soft Partitioning	Hard Partitioning
41	Cancel Number Formatting	Normal Number Formatting
42	Display -> I/O	I/O -> Display
43	Round to 13 Digits	
44	Set Alarm HH.MMSS	Reset Alarm
45	Tone	
46	Tone on Error	Don't Tone on Error
47	Tone on Cue	Don't Tone on Cue
48	Copy CRAM	
49	Number CRAM	Un-number Numbered CRAM
50	Eliminate LRN PC	Restore LRN PC
<del>A-Z</del>	<del>Increment Register A-Z</del>	<del>Decrement Register A-Z</del>

Late July 1980

<u>Key Sequence</u>	<u>Function Name</u>	<u>[Dfn] [OP] Message</u>
[OP] 00	DEFINE OP CODES	OP DEFINITIONS
[OP] 01	SET DEFAULTS	SET DEFAULTS
[OP] 02	DEFAULT PARTITION	480 PGM STEPS
[OP] 03	SET PARTITIONING	SET PARTITION
[OP] 04	ALL RESPONSE CUE	ALL CUE
[OP] 05	YES/NO CUE	YES/NO CUE
[OP] 06	ENT/CONT CUE	ENT/CONT CUE
[OP] 07	CONTINUE CUE	CONT CUE
[OP] 08	RECALL ERROR CODE	ERROR MESSAGE/ $\alpha$
[OP] 09	RECALL ALPHA	RECALL ALPHA
[OP] 10	ABSOLUTE VALUE	ABSOLUTE VALUE
[OP] 11	SIGNUM FUNCTION	SIGNUM FUNCTION
[OP] 12	ANGULAR MODE	ANGLE MODE
[OP] 13	ROUND DISPLAY REGISTER	ROUND DISPLAY
[OP] 14	RIGHT CIRCULAR SHIFT	->ALPHA->
[OP] 15	LEFT CIRCULAR SHIFT	<-ALPHA<-
[OP] 16	HEXIDECIMAL MODE	HEX MODE
[OP] 17	DECIMAL MODE	DECIMAL MODE
[OP] 18	TURN ON IMPLIED MULTIPLICATION	IMPLIED MULTIPLY
[OP] 19	CANCEL IMPLIED MULTIPLICATION	NO IMPLIED MULT
[OP] 20	SAVE USERS FLAGS	SAVE FLAGS
[OP] 21	EXCHANGE FLAGS	EXCHANGE FLAGS
[OP] 22	CONVERT DEGREES TO RADIANS	D->R CONVERSION
[OP] 23	CONVERT RADIANS TO DEGREES	R->D CONVERSION
[OP] 24	CONVERT RADIANS TO GRADS	R->G CONVERSION
[OP] 25	CONVERT GRADS TO RADIANS	G->R CONVERSION
[OP] 26	CONVERT GRADS TO DEGREES	G->D CONVERSION
[OP] 27	CONVERT DEGREES TO GRADS	D->G CONVERSION
[OP] 28	CALCULATOR TEST 1	TEST 1
[OP] 29	CALCULATOR TEST 2	TEST 2
[OP] 30	DISPLAY CALCULATOR SETTINGS	SHOW STATUS
[OP] 31	CLEAR STATISTICS REGISTERS	CLEAR STATISTICS
[OP] 32	COMPUTE INTERCEPT AND SLOPE	INTERCEPT<=>SLOPE
[OP] 33	COMPUTE CORRELATION COEFFICIENT	CORRELATION COEF
[OP] 34	Y PREDICTION	$Y=mX + b$

Late July 1980

<u>Key Sequence</u>	<u>Function Name</u>	<u>[Dfn] [OP] Message</u>
[OP] 35	X PREDICTION	$X=(Y-b)+m$
[OP] 36	COMPUTE MEANS	MEANS ( $Y \Leftarrow X$ )
[OP] 37	COMPUTE STANDARD ERROR OF MEANS	STD ERR OF MEAN
[OP] 38	COMPUTE STANDARD DEVIATION (N)	N STD DEV ( $Y \Leftarrow X$ )
[OP] 39	COMPUTE STANDARD DEVIATION (N-1)	N-1 STD DEV ( $Y \Leftarrow X$ )
[OP] 40	LIST PROGRAM LABELS	LIST PGM LABELS
[OP] 41	TEST PRIMARY PORT MODULE NUMBER	PRIMARY MODULE $\alpha$
[OP] 42	NORMALIZED NUMBER MODE	NORMALIZED $\alpha$ 'S
[OP] 43	UNNORMALIZED NUMBER MODE	UNNORMALIZED $\alpha$ 'S
[OP] 44	HARD PARTITIONING	HARD PARTITION
[OP] 45	SOFT PARTITIONING	SOFT PARTITION
[OP] 46	SET PROGRAM COUNTER	DISP $\rightarrow$ PGM COUNTER
[OP] 47	READ PROGRAM INSTRUCTION	PGM STEP $\rightarrow$ DISP
[OP] 48	WRITE PROGRAM INSTRUCTION	DISP $\rightarrow$ PGM STEP
[OP] 49	READ CASSETTE INTO MAIN MEMORY	READ CASSETTE MAIN MEMORY
[OP] 50	WRITE MAIN MEMORY TO CASSETTE	WRITE CASSETTE MAIN MEMORY
[OP] 51	READ CASSETTE INTO NUMBERED CONSTANT MEMORY MODULE	READ CASSETTE NUMBERED MODULE
[OP] 52	WRITE NUMBERED CONSTANT MEMORY MODULE TO CASSETTE	WRITE CASSETTE NUMBERED MODULE
[OP] 53	READ CASSETTE INTO PROGRAM MEMORY	READ CASSETTE PROGRAM STEPS
[OP] 54	WRITE PROGRAM MEMORY TO CASSETTE	WRITE CASSETTE PROGRAM STEPS
[OP] 55	READ CASSETTE INTO DATA REGISTER MEMORY	READ CASSETTE REGISTERS
[OP] 56	WRITE DATA REGISTER MEMORY TO CASSETTE	WRITE CASSETTE REGISTERS
[OP] 57	TRANSMIT DISPLAY DATA	DISPLAY $\rightarrow$ I/O
[OP] 58	RECEIVE DISPLAY DATA	I/O $\rightarrow$ DISPLAY
[OP] 59	12 HOUR MODE	12 HOUR CLOCK
[OP] 60	24 HOUR MODE	24 HOUR CLOCK
[OP] 61	DEFAULT PAUSE TIMING	SET PAU TO 1.5

*Late July 1980*

<u>Key Sequence</u>	<u>Function Name</u>	<u>[Dfn] [OP] Message</u>
[OP] 62	SET PAUSE TIMING	SET PAU TIMING
[OP] 63	TURN ALARM ON	SET CLOCK ALARM
[OP] 64	TURN ALARM OFF	CLOCK ALARM OFF
[OP] 65	TONE	TONE
[OP] 66	TURN ON ERROR TONE	TONE ON ERROR
[OP] 67	TURN OFF ERROR TONE	NO TONE ON ERROR
[OP] 68	TURN ON CUE TONE	TONE ON CUE
[OP] 69	TURN OFF CUE TONE	NO TONE ON CUE
[OP] 70	DISPLAY FLAGS SET	SHOW FLAGS SET
[OP] 71	13 DIGIT DISPLAY FORMAT	SHOW 13 DIGITS
[OP] 72	ERASE PRIMARY PORT MODULE	ERASE MODULE
[OP] 73	NUMBER PRIMARY PORT MODULE	NUMBER MODULE
[OP] 74	COPY PRIMARY PORT MODULE	COPY MODULE
[OP] 75	DISPLAY MODULE STATUS	MODULE STATUS
[OP] 76	RESTORE PROGRAM COUNTER	SHOW LRN PC
[OP] 77	ELIMINATE PROGRAM COUNTER	ELIMINATE LRN PC



March 1981

APPENDIX D  
LIST OF OP CODES

Key Sequence	Function Name	[INV] [OP] Message
[OP] 00	DEFINE OP CODES	OP DEFINITIONS
[OP] 01	SET DEFAULTS	SET DEFAULTS
[OP] 02	DISPLAY CALCULATOR SETTINGS	SHOW STATUS
[OP] 03	RECALL ERROR CODE	ERROR MESSAGE/ $\alpha$
[OP] 04	ALL RESPONSE CUE	ALL CUE
[OP] 05	YES/NO CUE	YES/NO CUE
[OP] 06	ENT/CONT CUE	ENT/CONT CUE
[OP] 07	CONTINUE CUE	CONT CUE
[OP] 08	ALPHA ENTRY TABLE	ENTRY TABLE
[OP] 09	RECALL ALPHA	RECALL ALPHA
[OP] 10	RIGHT CIRCULAR SHIFT	->ALPHA->
[OP] 11	LEFT CIRCULAR SHIFT	<-ALPHA<-
[OP] 12	13 DIGIT DISPLAY FORMAT	SHOW 13 DIGITS
[OP] 13	ROUND DISPLAY REGISTER	ROUND DISPLAY
[OP] 14	UNFORMATTED DISPLAY MODE	*UNFORMATTED MODE
[OP] 15	FORMATTED DISPLAY MODE	*FORMATTED MODE
[OP] 16	HEXIDECIMAL MODE	HEX MODE
[OP] 17	DECIMAL MODE	DECIMAL MODE
[OP] 18	DISPLAY FLAG DEFINITIONS	FLAG DEFINITIONS
[OP] 19	DISPLAY FLAGS SET	SHOW FLAGS SET
[OP] 20	SAVE USERS FLAGS	SAVE FLAGS
[OP] 21	EXCHANGE FLAGS	EXCHANGE FLAGS
[OP] 22	DEFAULT PAUSE TIMING	SET PAU TO 1.5
[OP] 23	SET PAUSE TIMING	SET PAU TIMING
[OP] 24	TURN ON IMPLIED MULTIPLICATION	IMPLIED MULTIPLY
[OP] 25	CANCEL IMPLIED MULTIPLICATION	NO IMPLIED MULT
[OP] 26	ABSOLUTE VALUE	ABSOLUTE VALUE
[OP] 27	SIGNUM FUNCTION	SIGNUM FUNCTION
[OP] 28	CONVERT D.MS TO DECIMAL DEGREES	D.MMSS->D.d
[OP] 29	CONVERT DECIMAL DEGREES TO D.MS	D.d->D.MMSS
[OP] 30	ANGULAR MODE	ANGLE MODE
[OP] 31	CONVERT DEGREES TO RADIANS	D->R CONVERSION
[OP] 32	CONVERT RADIANS TO DEGREES	R->D CONVERSION
[OP] 33	CONVERT RADIANS TO GRADS	R->G CONVERSION
[OP] 34	CONVERT GRADS TO RADIANS	G->R CONVERSION
[OP] 35	CONVERT GRADS TO DEGREES	G->D CONVERSION
[OP] 36	CONVERT DEGREES TO GRADS	D->G CONVERSION
[OP] 37	CLEAR STATISTICS REGISTERS	CLEAR STATISTICS
[OP] 38	COMPUTE INTERCEPT AND SLOPE	INTERCEPT<>SLOPE
[OP] 39	COMPUTE CORRELATION COEFFICIENT	CORRELATION COEF
[OP] 40	Y PREDICTION	$Y=mX + b$
[OP] 41	X PREDICTION	$X=(Y-b):m$
[OP] 42	COMPUTE MEANS	MEANS (Y<>X)
[OP] 43	COMPUTE STANDARD ERROR OF MEANS	STD ERR OF MEAN
[OP] 44	COMPUTE STANDARD DEVIATION(N)	N STD DEV(Y<>X)
[OP] 45	COMPUTE STANDARD DEVIATION(N-1)	N-1 STD DEV(Y<>X)

\*Changed from unnormalized and normalized.

March 1981

<u>Key Sequence</u>	<u>Function Name</u>	<u>[INV] [OP] Message</u>
[OP] 46	SET PROGRAM COUNTER	DISP-->PGM COUNTER
[OP] 47	COPY PROGRAM INSTRUCTION TO DISPLAY	PGM STEP-->DISP
[OP] 48	COPY PROGRAM INSTRUCTION TO PROGRAM STEP	DISP-->PGM STEP
[OP] 49	DEFAULT PARTITION	480 PGM STEPS
[OP] 50	SET PARTITIONING	SET PARTITION
[OP] 51	SOFT PARTITIONING	SOFT PARTITION
[OP] 52	HARD PARTITIONING	HARD PARTITION
[OP] 53	ELIMINATE PROGRAM COUNTER	ELIMINATE LRN PC
[OP] 54	RESTORE PROGRAM COUNTER	SHOW LRN PC
[OP] 55	LIST PROGRAM LABELS	LIST PGM LABELS
[OP] 56	CALCULATOR TEST 1	TEST 1
[OP] 57	CALCULATOR TEST 2	TEST 2
[OP] 58	COPY CASSETTE TO MAIN MEMORY	TAPE-->MAIN MEMORY
[OP] 59	COPY MAIN MEMORY TO CASSETTE	MAIN MEMORY-->TAPE
[OP] 60	COPY CASSETTE TO PROGRAM MEMORY	TAPE-->PGM MEMORY
[OP] 61	COPY PROGRAM MEMORY TO CASSETTE	PGM MEMORY-->TAPE
[OP] 62	COPY CASSETTE TO DATA MEMORY	TAPE-->DATA MEMORY
[OP] 63	COPY DATA MEMORY TO CASSETTE	DATA MEMORY-->TAPE
[OP] 64	COPY CASSETTE TO MODULE	TAPE-->MODULE
[OP] 65	COPY MODULE TO CASSETTE	MODULE-->TAPE
[OP] 66	COPY MODULE PROGRAM TO MEMORY	MODULE PGM-->MAIN
[OP] 67	COPY PROGRAM TO MODULE	MAIN PGM-->MODULE
[OP] 68	TEST PRIMARY PORT MODULE NUMBER	PRIMARY MODULE $\alpha$
[OP] 69	DISPLAY MODULE STATUS	MODULE STATUS
[OP] 70	NUMBER PRIMARY PORT MODULE	NUMBER MODULE
[OP] 71	ERASE PRIMARY PORT MODULE	ERASE MODULE
---86 ends here---		
[OP] 72	COPY MODULE TO MODULE	COPY MODULE
[OP] 73	24 HOUR MODE	24 HOUR CLOCK
[OP] 74	12 HOUR MODE	12 HOUR CLOCK
[OP] 75	SET ALARM TIME	SET ALARM TIME
[OP] 76	TURN ALARM ON	CLOCK ALARM ON
[OP] 77	TURN ALARM OFF	CLOCK ALARM OFF
[OP] 78	TONE	TONE
[OP] 79	TURN ON ERROR TONE	TONE ON ERROR
[OP] 80	TURN OFF ERROR TONE	NO TONE ON ERROR
[OP] 81	TURN ON CUE TONE	TONE ON CUE
[OP] 82	TURN OFF CUE TONE	NO TONE ON CUE
[OP] 83	TRANSMIT DISPLAY DATA	DISPLAY-->I/O
[OP] 84	RECEIVE DISPLAY DATA	I/O-->DISPLAY